

LISTING OF CLAIMS

Cancel claims 2-14, and substitute the following claims:

Claim 1. (Original) A method for drill guidance, comprising:

determining a planned path for a borehole;
positioning a localized magnetic field source with respect to said planned path;
orienting said field source with respect to gravity;
causing said source to generate first and second magnetic fields, alternating polarity;
measuring, at a measurement location in a borehole being drilled, the vector components of said first and second magnetic fields and the vector components of gravity at the measurement location; and
determining the distance and direction between the measurement location and the magnetic field source.

Claims 2-14 (Canceled).

Claim 15 (New). A magnetic field source, comprising:

a base;
a turntable mounted on said base to rotate about an axis;
an adjustable support for said base for vertically assigning said axis, whereby said turntable is rotatable in a horizontal plane; and
an elongated solenoid having an axis, said solenoid being mounted on and rotatable with said turntable, said solenoid axis remaining horizontal at all azimuthal orientations as said turntable rotates, said solenoid being energizable to generate a magnetic field beacon.

Claim 16 (New). The magnetic field source of claim 15, wherein said turntable is rotatable between first and second fixed position, said solenoid axis in said first position being perpendicular to said solenoid axis in said second position, said solenoids being energizable in said first and second positions to produce first and second mutually perpendicular magnetic fields.

Claim 17 (New). The magnetic field source of claim 16, further including an orientation ring on said base, rotatable about said turntable axis, and fixable on said base at any selected azimuthal orientation, said turntable being engageable with said orientation ring at said first and second positions.

Claim 18 (New). The magnetic field source of claim 15, further including a second elongated solenoid having an axis, said second solenoid being mounted on said turntable with the axes of said first and second solenoids being mutually perpendicular.

Claim 19 (New). The magnetic field source of claim 18, wherein said turntable is fixed at any selected azimuthal orientation, said solenoids being energizable to produce mutually perpendicular magnetic fields.

Claim 20 (New). A device for drill guidance, comprising:

a localized magnetic field source having an axis;

means for positioning said source at a known location with respect to a borehole to be drilled;

means for orienting said source axis with respect to the earth's gravity and a known azimuthal direction;

means for energizing said source to generate first and second magnetic fields in the path of the borehole to be drilled, each of said fields having an alternating polarity;

sensors adapted to be positioned at a measurement location in a borehole being drilled to measure vector components of said first and second magnetic fields and of the earth's gravity at said measurement location; and

means responsive to said measured vector components to determine the distance and direction from the measurement location to the source.

Claim 21 (New). The device of claim 20, wherein said source is an elongated solenoid mounted on a turntable for rotation in a horizontal plane about a vertical axis.

Claim 22 (New). The device of claim 21, wherein said means for orienting said source axis includes an adjustable support for said turntable.

Claim 23 (New). The device of claim 22, wherein said solenoid is rotatable between first and second positions, and wherein said means for energizing said source to generate said first and second fields comprises energizing said solenoid at said first and second positions, respectively.

Claim 24 (New). The device of claim 23, wherein said first and second positions are substantially perpendicular to each other.

Claim 25 (New). The device of claim 20, wherein said source comprises first and second elongated solenoids having mutually perpendicular axes and energizable to generate said first and second magnetic fields, respectively.

Claim 26 (New). The device of claim 21, wherein said solenoids are mounted for rotation in a horizontal plane.

Claim 27 (New). The device of claim 20, wherein said means for orienting said source axis includes means for positioning said axis in a first known azimuthal direction while generating said first magnetic field and for positioning said axis in a second known azimuthal direction while generating said second magnetic field.

Claim 28 (New). The device of claim 27, wherein said first and second axis directions are mutually perpendicular.

Claim 29 (New). The device of claim 28, wherein said first and second axis directions are in a horizontal plane.

Claim 30 (New). The device of claim 20, wherein said means for energizing said source includes a reversible current.

Claim 31 (New). The device of claim 20, wherein said means for energizing said source comprises a fixed rate reversible current.

Claim 32 (New). The device of claim 20 wherein said source comprises first and second mutually perpendicular solenoids, and wherein said means for energizing said source comprises a periodically reversible current supplied to said solenoids.